

Perimeter with Polygons

Brief Overview:

Finding the perimeter of objects and polygons is an important skill to continue to develop and master by the fourth grade. Students should have various opportunities to use real life experiences using standard and non-standard forms of measurement to find perimeter. Given these opportunities within the math classroom, students can explore a variety of formulas and computational skills in order to obtain an outcome. The instructional leader can provide experiences to develop conceptual thought and design.

NCTM Content Standard/National Science Education Standard:

Measurement

- 1. Understand measurable attributes of objects and the units, systems, and processes of measurement.**
 - Understand the need for measuring with standard units and become familiar with standard units in the customary and metric systems.
- 2. Apply appropriate techniques, tools, and formulas to determine measurements.**
 - Develop strategies for estimating the perimeters of irregular shapes.

Geometry

- 1. Use visualization, spatial reasoning, and geometric modeling to solve problems.**
 - Use geometric models to solve problems in other areas of mathematics such as measurement.

Grade/Level:

Grade 4

Duration/Length:

3 days (60 – 90 minutes each day).

Student Outcomes:

Students will:

- Be able to apply measurement concepts by determining the perimeter of polygons and creating polygons with given perimeters using standard and non-standard units of measurement.

- Be able to create a variety of polygons with a perimeter of 10 units.
- Be able to use formulas, strategies, and spatial sense to find the perimeter of polygons with missing lengths of sides.

Materials and Resources:

Lesson 1

- Masking Tape
- 4 tape measures
- Sentence strip with definition of perimeter
- Chart Paper
- 1 Overhead geoboard
- Rubber bands for each student
- 1 geoboard for each pair of students
- Teacher Resource 1
- Student Resources 1, 2, 3

Lesson 2

- Chart
- Teacher Resources 2,3
- Student Resources 4, 5, 6

Lesson 3

- Chart paper
- Envelopes
- Scissors
- Teacher Resources 4,5,6
- Student Resources 7, 8, 9, 10, 11

Development/Procedures:

Lesson 1

Teacher Preparation

Before teaching the lesson the teacher will need to create a square using masking tape on the classroom floor. The teacher may want to use a tape measure to ensure a large and accurate shape.

Pre-Assessment

How would you measure the distance around the shape on the floor?

Launch


- Have students examine the shape on the floor. Introduce the question, How would you measure the distance around the shape on the floor? What tools might you use? What might you need to know about measuring distance of a figure on the floor?
- Invite students to share their thoughts. Discuss responses and list on large chart paper. Ask questions to solicit responses such as, what could you use other than a ruler? Possible responses: straws, hands, pencils, etc.
- Hold a brief discussion on standard and non-standard units of measurements. Standard: ruler, tape measure, yardstick, etc.; non-standard: footsteps, paper clips etc.
- Invite four volunteers to measure the perimeter of the figure on the floor using a non standard unit of measurement. Each student will measure one side of the square figure on the floor and record their measurement on the front board. A final volunteer will record each measurement on the board and add up the number of units on each side.
- Invite four different volunteers to measure the perimeter of the figure on the floor using an inch tape measure, a standard unit of measurement. Each student will measure one side of the square figure on the floor and record their measurement on the front board. A final volunteer will come to the board and add the four numbers up and label the unit as inches.
- Discuss the difference between the standard and non-standard way of measuring the perimeter of the square figure on the floor and why standard measurement is beneficial.

Teacher Facilitation

Explain to students that they just explored ways to find the perimeter of an object. Display the definition of perimeter on a sentence strip or on the classroom visualizer. *To find the perimeter you add the distance around an object or you can use the formula $2L + 2W$.*

- Display a geoboard polygon (3 X 3 square) on the visualizer. Ask the students, “How do I find the perimeter of this square? (Possible responses: add the distance around the figure; $2L + 2W$; or count the units on each side.”
- Model counting the units around the square. Be sure that students understand not to count the pegs, rather the space between each peg.

Be sure to model counting each space only one time. (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 = 12 units)

- Model counting the units on each side of the square and then adding the four numbers up. ($3 + 3 + 3 + 3 = 12$ units)
- Model using the formula $2L + 2W$. ($(3 \times 2) + (3 \times 2) = 6 + 6 = 12$ units.)
- Explain to students that each answer has a number and a unit.
- Create another figure on the geoboard: 
- Ask students to find the perimeter and explain how they found the answer. Discuss.
- Invite students to help you create a shape on the geoboard with a perimeter of 10. Model creating different shapes with a perimeter of 10 and adding the distance around the figure.

Student Application

- Assign partners and distribute materials.
- Each pair of students will receive a geoboard and dot paper.
- Each pair of students will engage in a ‘Think-Pair-Share’ activity in which they will discuss the question “Is a straight line with 2 pegs the same as a diagonal line between 2 pegs?” Discuss responses.
- Students will work with their partner creating shapes that have a perimeter of 12. One student will use the geoboard to create the shape while the other will draw the shape on dot paper.
- Establish rules, reminding students that shapes cannot be rotated, reflected, or translated. (Teacher Resource 1)
- Students are to create as many shapes as they can.
- Invite pairs to share their geoboards and drawing.

Closure

- Revisit the question: ‘How do you find perimeter?’
- What strategy did you use, if any?

Embedded Assessment

- Student Resource 2: Ticket Out The Door. Answer key can be found on Teacher Resource 6.

Reteaching/Extension

- Teacher will work with small groups of students who struggled with the assessment by using cut straws to create polygons, counting the

- Students will complete page two of Student Resource 3, where they will create shapes on grid paper with a given perimeter. Answer key can be found on Teacher Resource 6.

Lesson 2

Teacher Preparation

- The teacher will need to make overhead transparencies of Teacher Resource Sheet 2,3,4

Pre-assessment

- Observe student activity from launch activity below.

Launch

- Students will be given Student Resource 4, which is grid paper to plot points on the x and y-axis. This will also be displayed on an overhead. The students will work in groups of three to four to complete this activity. Once the coordinates are plotted on the grid students will connect the dots to form a polygon.
- Students will document one or two statements about their shape; name, number of sides, etc.
- Regroup students into whole group. Discuss the findings with the students. Record on chart paper for display. Compare and contrast results.

Teacher Facilitation

- As a whole group ask students, how they would find the perimeter of the shapes they created in the launch activity. Elicit responses from students. Discuss and review that the definition of *perimeter is the distance around an object or shape*. Ask students if they could find the perimeter of these shapes without using a ruler? Elicit responses.
- Display only first shape on Teacher Resource 2. Ask students if they can find the perimeter of this shape. Remind students that not all sides of this shape are labeled. Discuss with students what they know

about the sides that are labeled and their knowledge of a square. Can they find the perimeter of this shape without knowing the length of all the sides? Can the grid paper help you find the perimeter? Students should be able to reason that a square has four equal sides therefore only knowing one side would result in the formula, $P=4s$ for this shape.

- Display second shape on Teacher Resource 2. Ask students if they can find the perimeter of this shape. Note: All lengths of sides will not be given. Ask students if all sides of this polygon are the same? Will they be able to use the same formula as the first example? What strategy should they use to find the perimeter of this object? Discuss how to use the grid and the given lengths to help determine the answer.
- Display Teacher Resource 3. This polygon will not be on grid paper. Discuss with students what they know about this shape. Discuss with students how they can find the perimeter of this shape without all of the lengths given and without it being on a grid. Remind students that they will not be given a ruler to solve this problem. Discuss strategies with students as a whole group to find different strategies for solving the perimeter. Elicit responses.

Student Application

- Students will work independently to find the perimeter of shapes with and without given lengths using Student Resource 5. See Teacher Resource 6 for an answer key.
- Students will solve perimeter of shapes that are on grid paper and use different strategies to arrive at an answer. Students will also be given shapes that are not on grid paper and have missing lengths of given sides to solve. Students will need to use the strategies discussed in teacher facilitation in order to solve these challenging problems.

Embedded Assessment

- Students will share results of activity with the whole group. Teacher will take note of students who achieved success with the independent activity and students who struggled to solve a variety of the problems.

Reteaching/Extension

- Teacher will assign reteaching and extension activities according to observation of independent work.

- Students who need extra practice/reteaching will work in small group through a teacher-guided activity. Students will use shapes from Student Resource 6 to measure the perimeter using non-standard forms of measurement such as toothpicks or beans. Students will discuss answers and how they found the perimeter.
- Students who achieved a high level of success with the independent activity will also complete Student Resource 6 without using manipulatives.

Lesson 3

Teacher Preparation

- The teacher will need to make several copies of Teacher Resource 4. Next, the teacher will need to cut out the shapes and place a variety of them in envelopes. There should be at least 5 to 8 shapes in each envelope and enough envelopes for groups of three or four according to class size.

Pre-Assessment

- Observe student activity from launch activity below.

Launch

- The students will brainstorm elements of a community- i.e. buildings, stores, communities, and public agencies.
- Discuss what it means to develop a community. Why is planning important before building? What do you think a city planner does? How do city planners use math when doing their jobs? Record these ideas on chart paper.
- Review perimeter and different ways to find it. Ask students if they think a city planner would use perimeter in their job? How?

Teacher Facilitation

- Ask students to brainstorm what elements they would want to include in a town if they were asked to build/ become a city planner. What items in a community are important to you? Students should think about the questions, pair with a neighbor and share ideas quietly.

- **Model and explain the student activity to the whole group. Each pair of students will receive an envelope with different shapes that represent building found in a community. (Teacher Resource 4.)**
- **Display Student Resource 7. The teacher will then model how the shapes (buildings) can be arranged on the grid paper in a variety of ways. The students will discuss why buildings should go in certain locations. Ask students if they were developing a town would they place the fire department near or away from the houses? Students should be able to reason the importance of this question and understand the thinking of a planner when building a new town.**
- **Next, tell students that before finalizing their town and receiving a building permit they will need to find the perimeter of all of their buildings. Caution students that not all buildings will be regular squares and they will need to apply skills learned from the previous two lessons.**

Student Application

- **Students will be assigned to a partner to work on this assignment. The pairs will receive the Student Resource 7 and an envelope with shapes. Use Teacher Resource 4.**
- **Students will need to review the steps of the activity displayed on Teacher Resource 5. The students will need to spend time designing their town, laying it out spatially and with the idea of community functions. The students will then trace their shapes onto Students Resource 7.**
- **Next, the students will need to complete Student Resource 8. They will need to document the type of polygon their buildings are, and the perimeter of each building.**
- **Students will share their towns with the whole class or other pairs of students.**

Embedded Assessment

- **The teacher will display Student Resource 9. The students will observe the town that the teacher has created and answer a question to demonstrate understanding.**
- **The teacher will ask the students to explain if a building with a perimeter of ten units will fit in the space between building A and B.**

- Students will draw in their shape on Student Resource 9 and explain why or why not the building will fit.

Reteaching/Extension

- Scaffold the students based on need determined by student response to the embedded assessment after a quick review.
- For reteaching purposes the teacher can review items from any of the previous lessons. The teacher may use geoboards, non-standard forms of measurement or other manipulatives to further explain and teach skill.
- For students who have mastered the skill they can transfer two or three of their buildings onto Student Resource Sheet 10. The students will trace these building onto the $\frac{1}{2}$ inch grid paper and calculate the perimeter. The students will then answer questions on the Student Resource Sheet 10 about their findings.

Summative Assessment:

- Students will demonstrate an understanding of concepts and skills learned by completing an assessment. The assessment will include two selected response question and one brief constructed response questions. Students will be required to use math vocabulary and to clearly demonstrate their knowledge through communication. Use Student Resource 11. See Teacher Resource 6 for an answer key.

Appendix A

Teacher Resource 1 - How Many Shapes With a Perimeter of 12 Units Can You Make?

Teacher Resource 2 - What's the Perimeter?

Teacher Resource 3 - What's the Perimeter Now?

Teacher Resource 4 - Buildings (three pages)

Teacher Resource 5 - Steps to Create Your Town

Teacher Resource 6 - Answer Key

Appendix B

Student Resource 1 - Units of 12

Student Resource 2 - Exit Slip

Student Resource 3 - Reteaching/ Extension (two pages)

Student Resource 4 - Plot the Polygons

Student Resource 5 - Find the Perimeter (two pages)
Student Resource 6 - Continue to Practice
Student Resource 7 - Plan Your Town
Student Resource 8 - What Type of Building Do You Have?
Student Resource 9 - Can You Make It Fit?
Student Resource 10 - Is Your Town the Same Size?
Student Resource 11- Summative Assessment

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NAME _____ DATE _____

**HOW MANY SHAPES WITH A PERIMETER OF 12 UNITS
CAN YOU MAKE?**

- 1. Work with your assigned partner.**
 - 2. Use rubber bands and a geoboard to create as many shapes as you can with a perimeter of 12.**
 - 3. Remember shapes cannot be rotated, reflected, or translated.**
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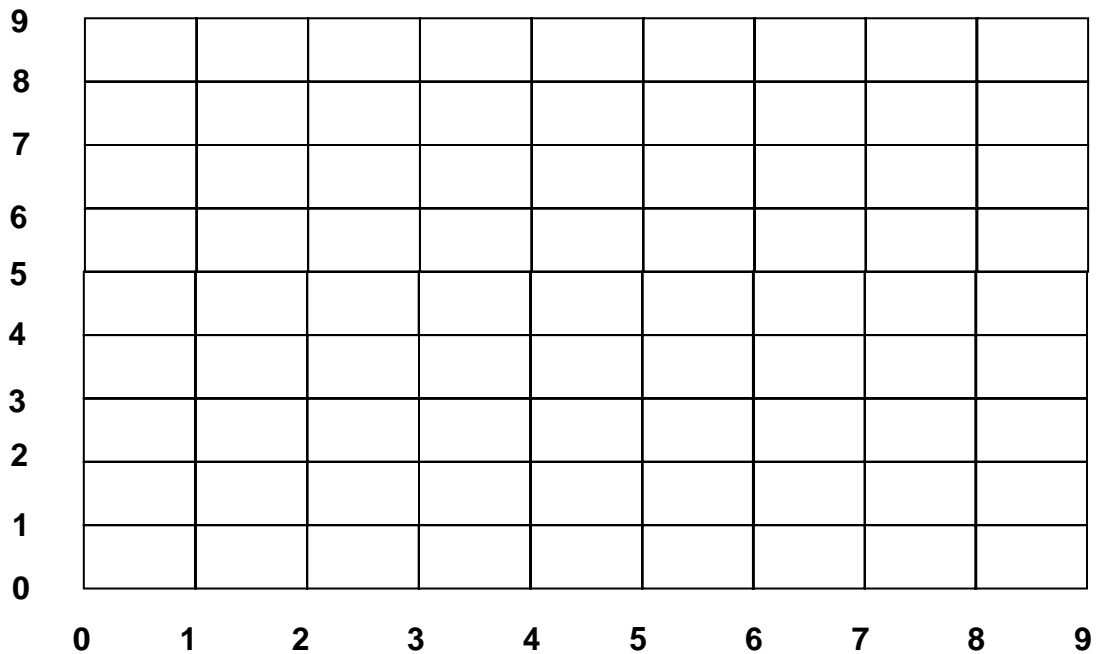
Answer the following questions on the back of Units of 12 worksheet. (Student Resource Sheet 1)

- How many shapes with a perimeter of 12 did you create?**

- What strategy did you use?** _____

Display the following ordered pairs for students to plot on the coordinate grid below. Make sure students connect the dots for each shape.

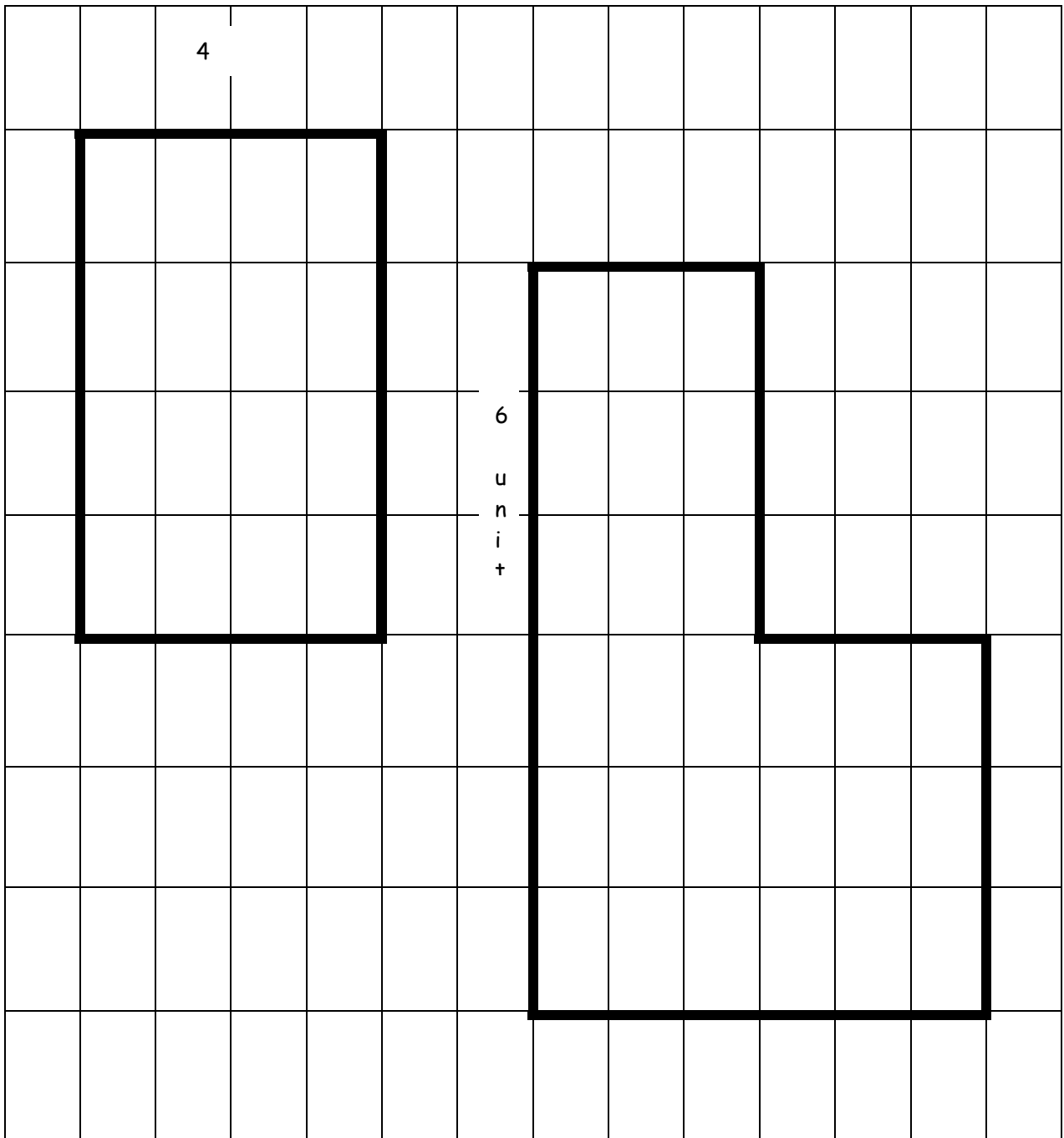
Delete – same as Student Resource 4

Shape #1**(1,1)****(1,4)****(3,4)****(3,1)****Shape #2****(4,6)****(4,9)****(5,9)****(5,7)****(6,7)****(6,6)****Shape #3****(4,2)****(4,5)****(7,4)**

What's the Perimeter?

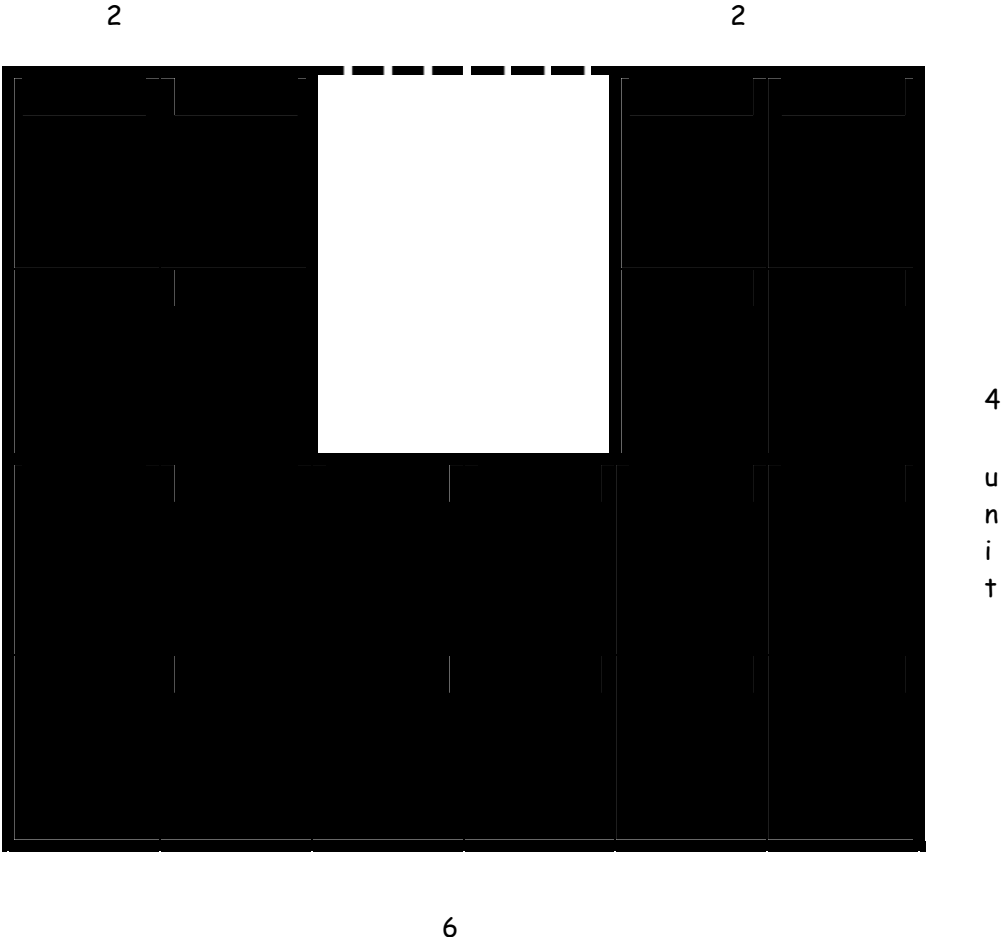
Teacher Resource 2

Please make these squares.



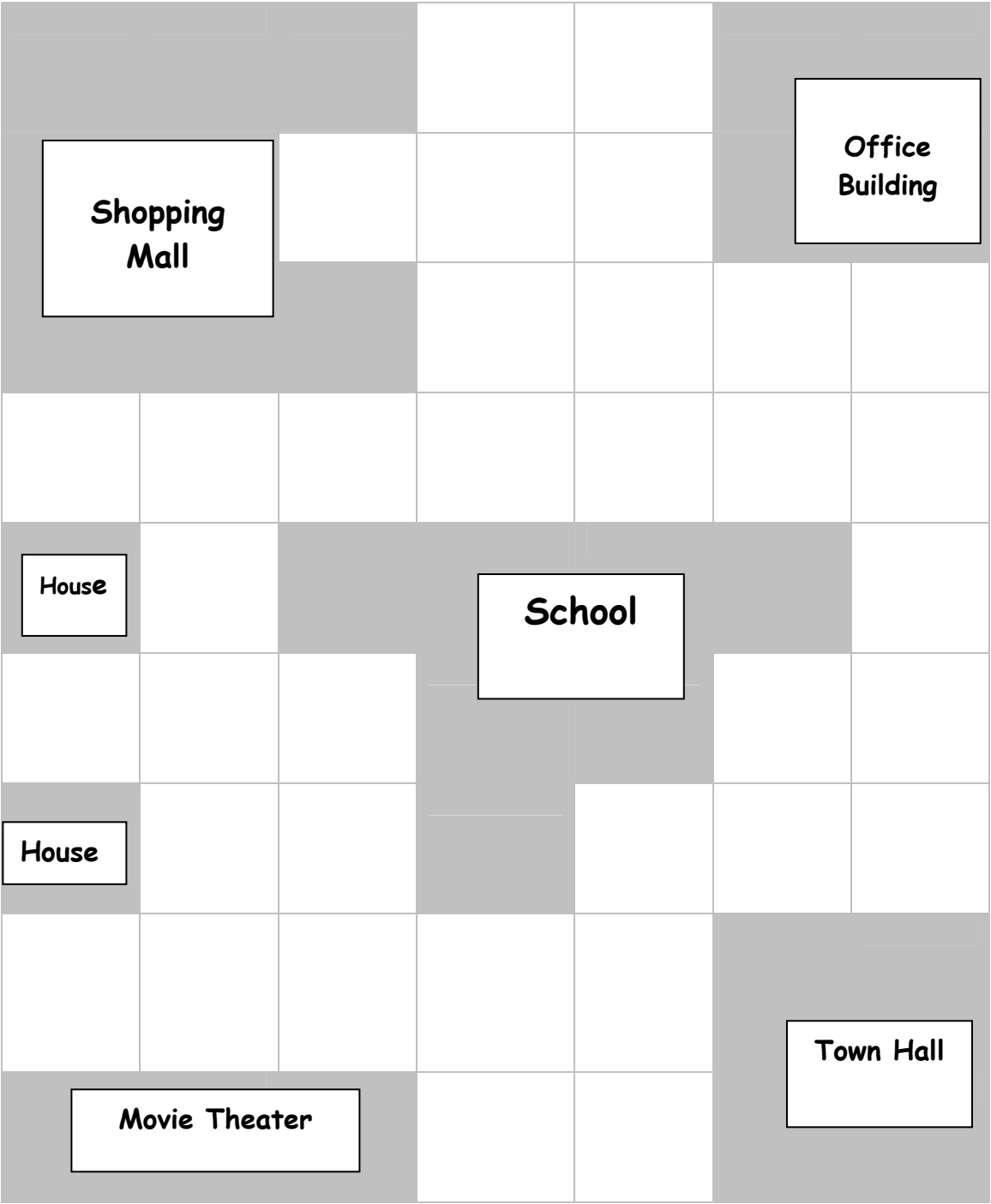
What's the Perimeter Now?

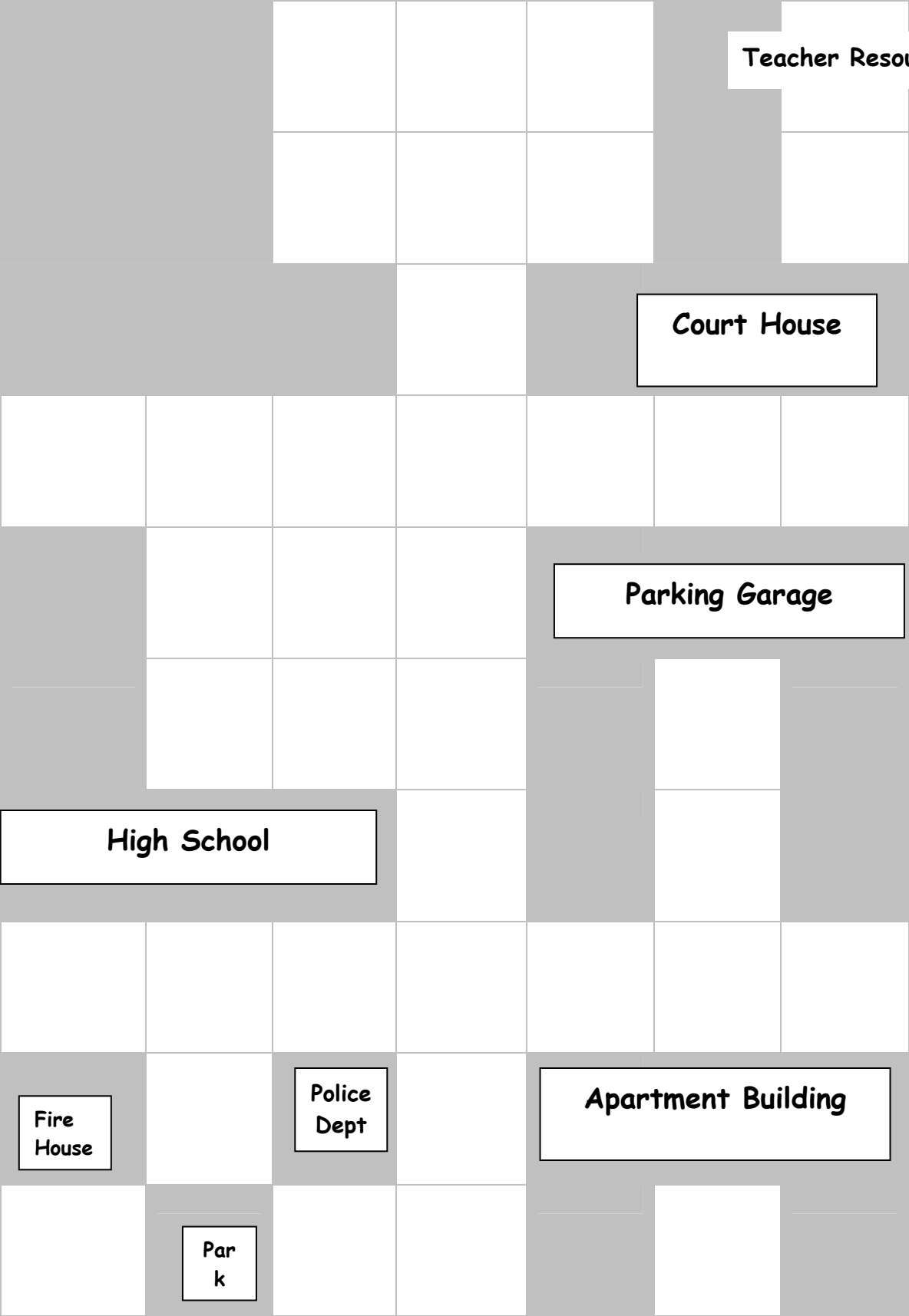
Teacher Resource 3



Buildings

Teacher Resource 4a





Teacher Resource 4b

Court House

Parking Garage

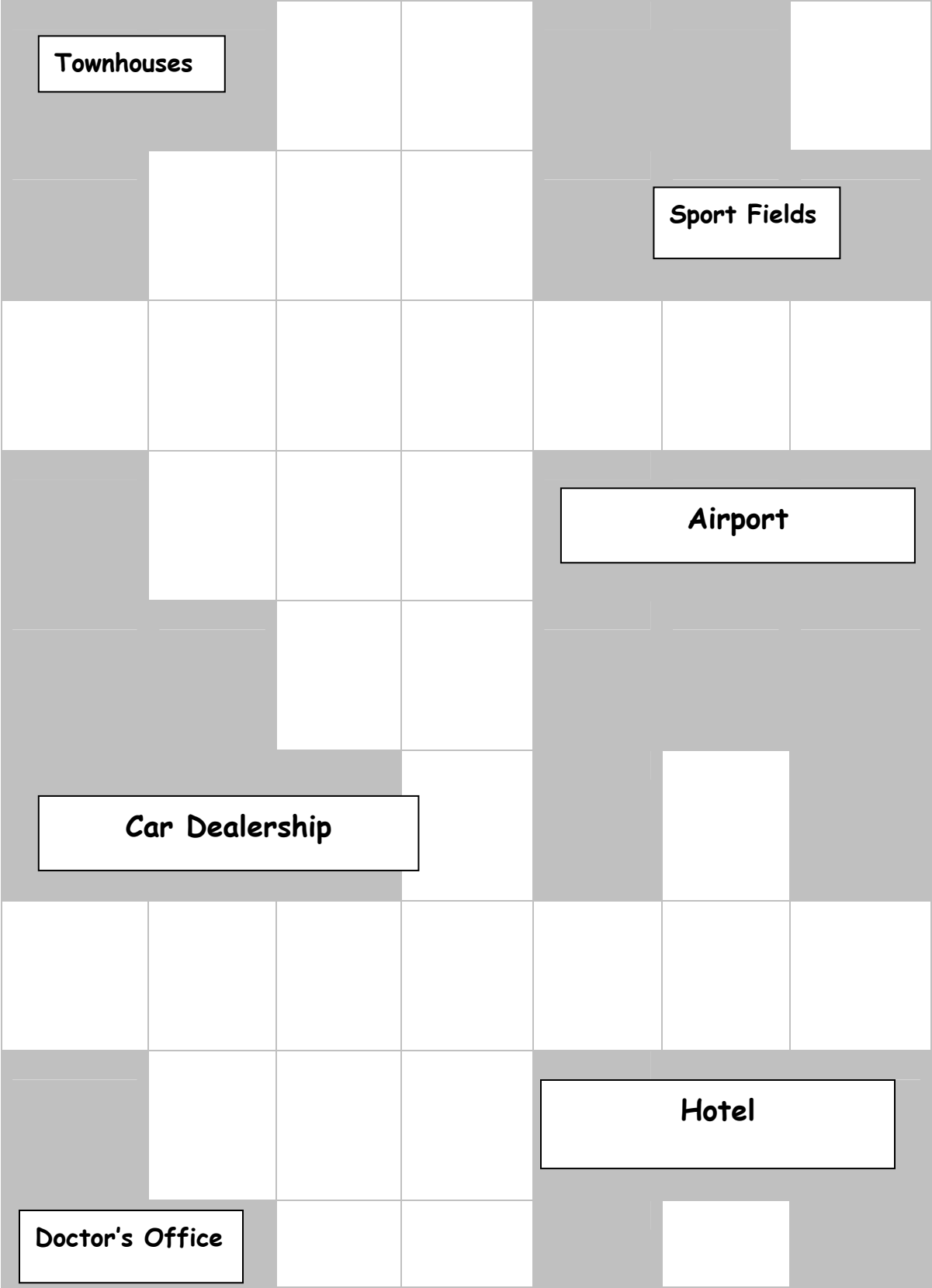
High School

Fire
House

Police
Dept

Apartment Building

Par
k



Steps to Create Your Town

- 1. With a partner write both of your names on your worksheet.**
- 2. Pull out all of your buildings from the envelope and examine the elements of your town.**
- 3. Take time to layout your buildings on your town (student resource sheet 7)**
- 4. Make sure your town layout makes sense.**
- 5. After you have finalized your design, trace and label all of your buildings.**
- 6. Complete Student Resource 8. Record the name of your building, what type of polygon it is and the perimeter of your building.**
- 7. Make sure you label your perimeter with units, since a standard form of measurement is not given.**

Answer Key

Teacher Resource 6a

Teacher Resource 1

The number of shapes that students are able to make and the strategies used will vary.

Student Resource 2

The students should have a clear understanding that perimeter means to measure the distance around a figure.

Student Resource 3

The answers are given going across for each row:

P= 8 units P= 12 units P= 14 units
P= 12 units P= 16 units P= 14 units
P= 14 units P= 18 units P= 20 units
P= 20 units P= 18 units P= 14 units

Second Page:

Student answers will vary.

Teacher Resource 3

Rectangular Shaped figure: All sides are 4 units. P = 16 units
'L' Shaped figure: Left side = 6 units
 Right side = 3 units, 3 units, 3 units
 Top = 3 units
 P = 24 units

Teacher Resource 4

Left outer side = 4 units
Left inner side = 2 units
Right inner side = 2 units
Inner middle = 2 units
P = 24 units

Student Resource 5

Page 1:

1. **P = 8 units**
2. **P = 12 units**
3. **P = 20 units**
4. **P = 20 units**
5. **P = 16 units**

Page 2:

6. **P = 40 cm**
7. **P = 108 in**
8. **P = 34 m**
9. **P = 48 km**
10. **P = 13 in**

Student Resource 6

1. **P = 32 units**
2. **P = 14 units**
3. **P = 22 units**
4. **P = 24 units**

Teacher Resource 5

Shopping Mall: P = 14 units
Office Building: P = 8 units
House: P = 4 units
House: P = 4 units
School: P = 14 units
Movie Theater: P = 10 units
Town Hall: P = 10 units
Hospital: P = 12 units
Court House: P = 12 units
High School: P = 12 units
Parking Garage: P = 16 units
Fire House: P = 4 units
Park: P = 4 units
Police Department: P = 4 units
Apartment Building: 12 units

Townhouses: P = 8 units
Sport fields: P = 10 units
Car Dealership: P = 12 units
Airport: P = 14 units
Doctor's Office: P = 8 units
Hotel: P = 12 units

Student Resource 7

Student answers will vary.

Student Resource 8

Student answers will vary. Perimeters should match answers in Teacher Resource 4.

Student Resource 9

Students can get a yes or no answer as long as their explanation supports their answer.

Yes, if the buildings can touch each other.

No, there is not enough room. The buildings will touch each other.

Student Resource 10

The Perimeter of the building did change because the scale of the grid is different. The first grid used an inch scale but the second grid used a quarter inch scale.

Student Resource 11

Selected Response:

P = 33 cm

P = 36 cm

Brief Constructed Response:

Step A

Length: 5 yards

Step B

I know that a rectangle has 2 sets of congruent sides. If the length is 14, I know that $14 + 14 = 28$ yards. That leaves me with 10 yards left because $38 - 28 = 10$. 2 sides divided by 10 is equal to 5. So the width of the rectangle is 5 yards.

Name:

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Exit Slip

Student Resource 2



What shapes were the easiest to calculate the perimeter?

For which shapes was it is most difficult?

What does perimeter mean?

Exit Slip

Student Resource 2

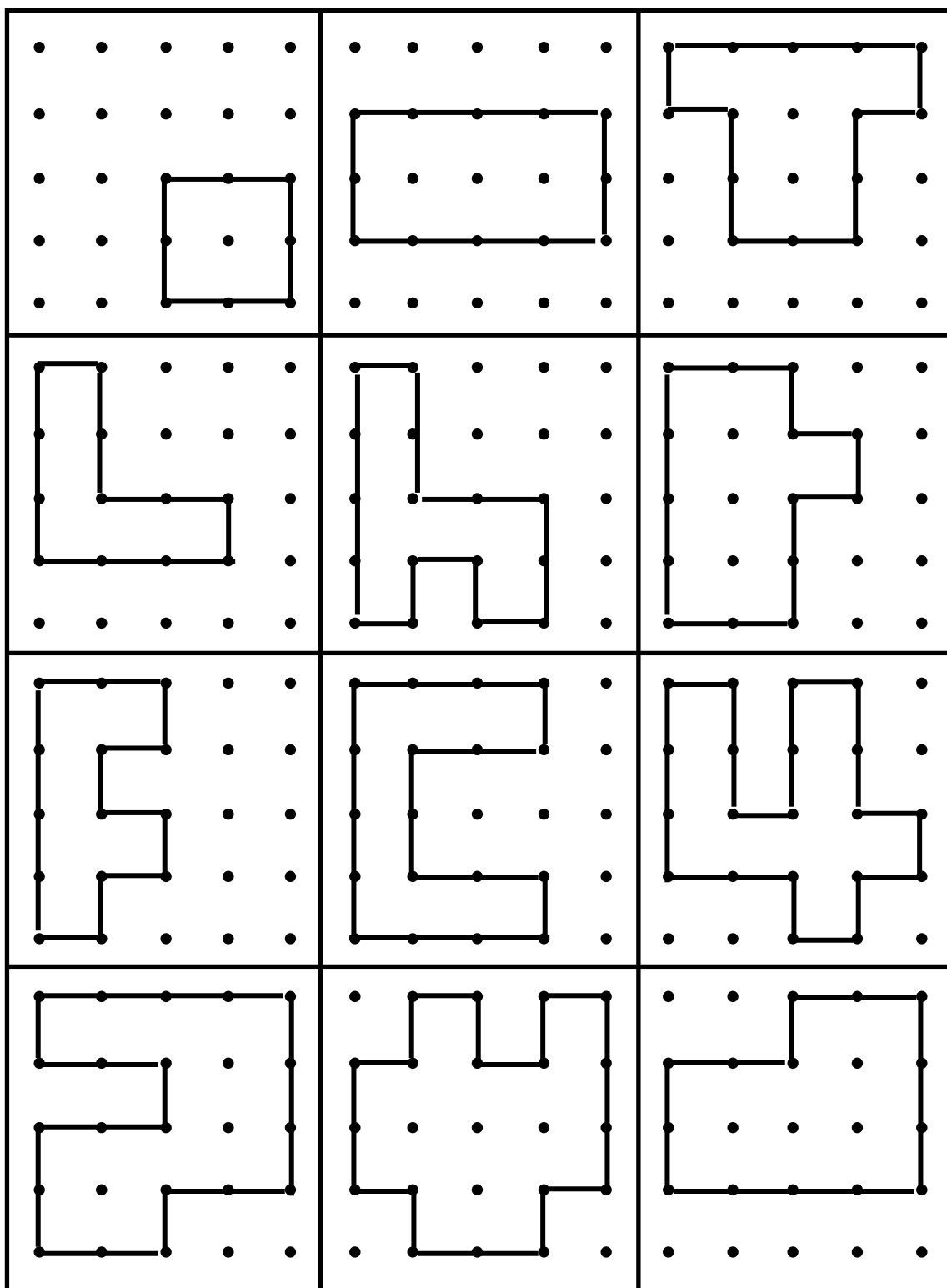


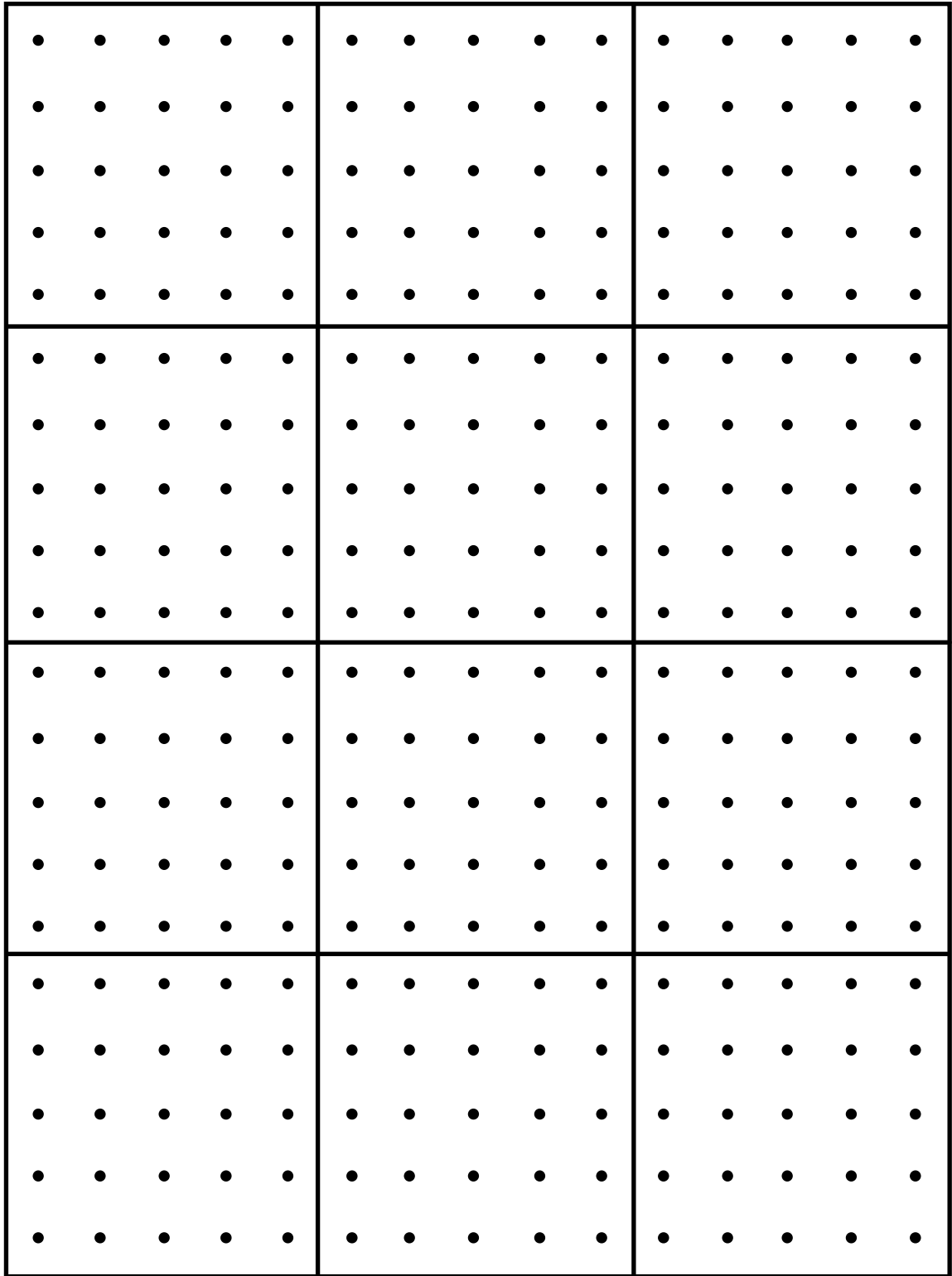
What shapes were the easiest to calculate the perimeter?

For which shapes was it most difficult?

What does perimeter mean?

Find the perimeter of each shape below.





Create shapes with a variety of perimeters. Use the following guidelines to help you

- | | | | | | |
|--------|----------|---------|----------|----------|---------|
| 1. P=4 | 2. P= 10 | 3. P=6 | 4. P=8 | 5. P= 14 | 6. P=12 |
| | 7. P= 15 | 8. P=17 | 9. P= 20 | | |

Plot the Polygon

Student Resource 4

Plot the ordered pairs on the coordinate grid below. Connect the dots for each shape.

Shape #1

(1,1)

(1,4)

(3,4)

(3,1)

Shape #2

(4,6)

(4,9)

(5,9)

(5,7)

(6,7)

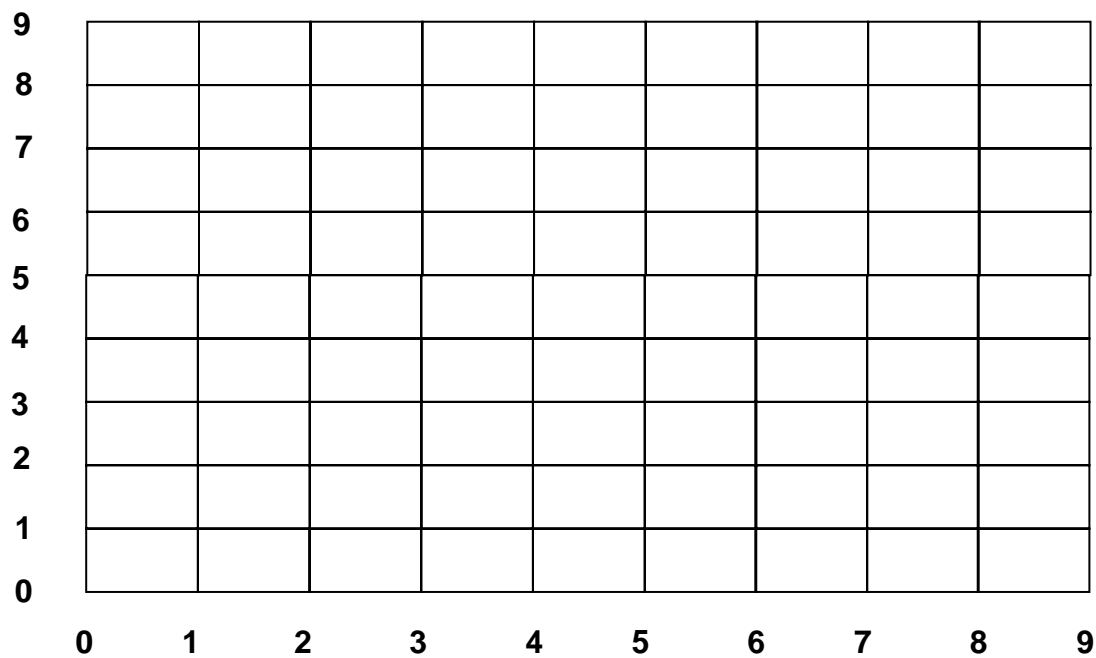
(6,6)

Shape #3

(4,2)

(4,5)

(7,4)



Student Resource 5

2

P=

3
u
n
i
t
-

P=

3.

P =

4

5 units

4.

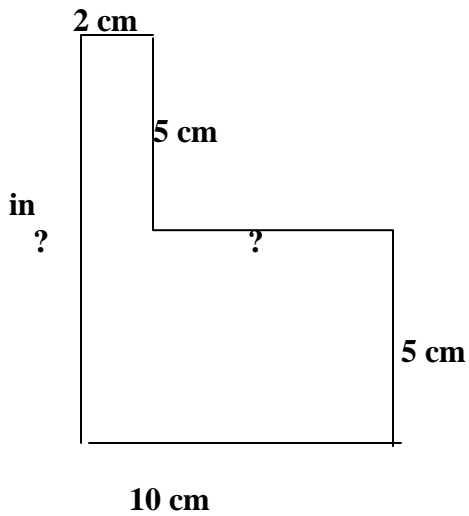
P=

5.

4 units

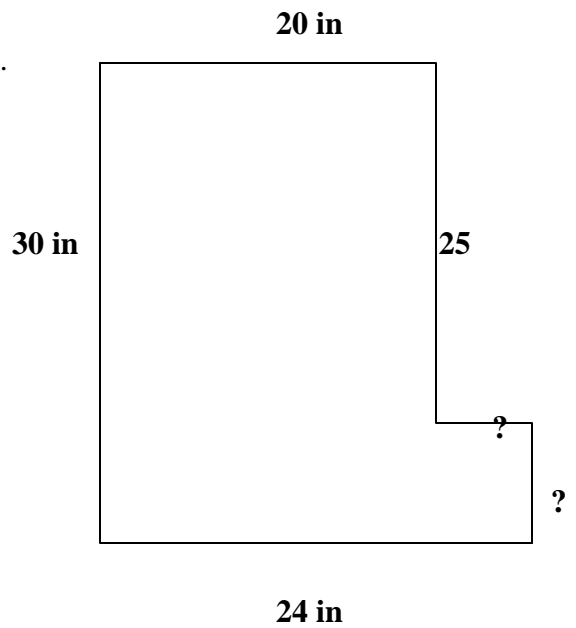
P=

6.



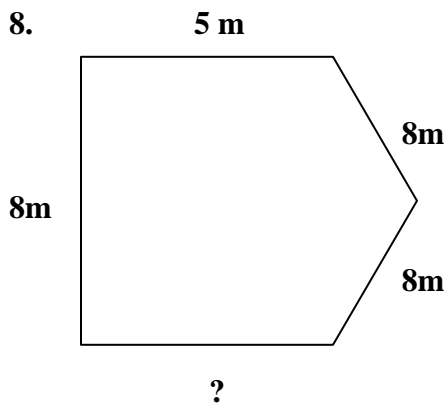
Perimeter = _____

7.



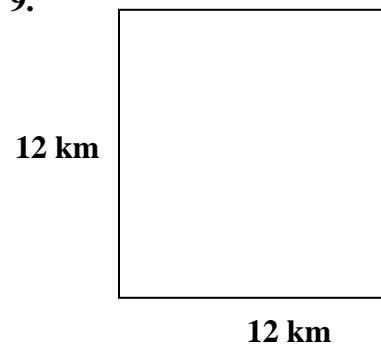
Perimeter = _____

8.



Perimeter= _____

9.

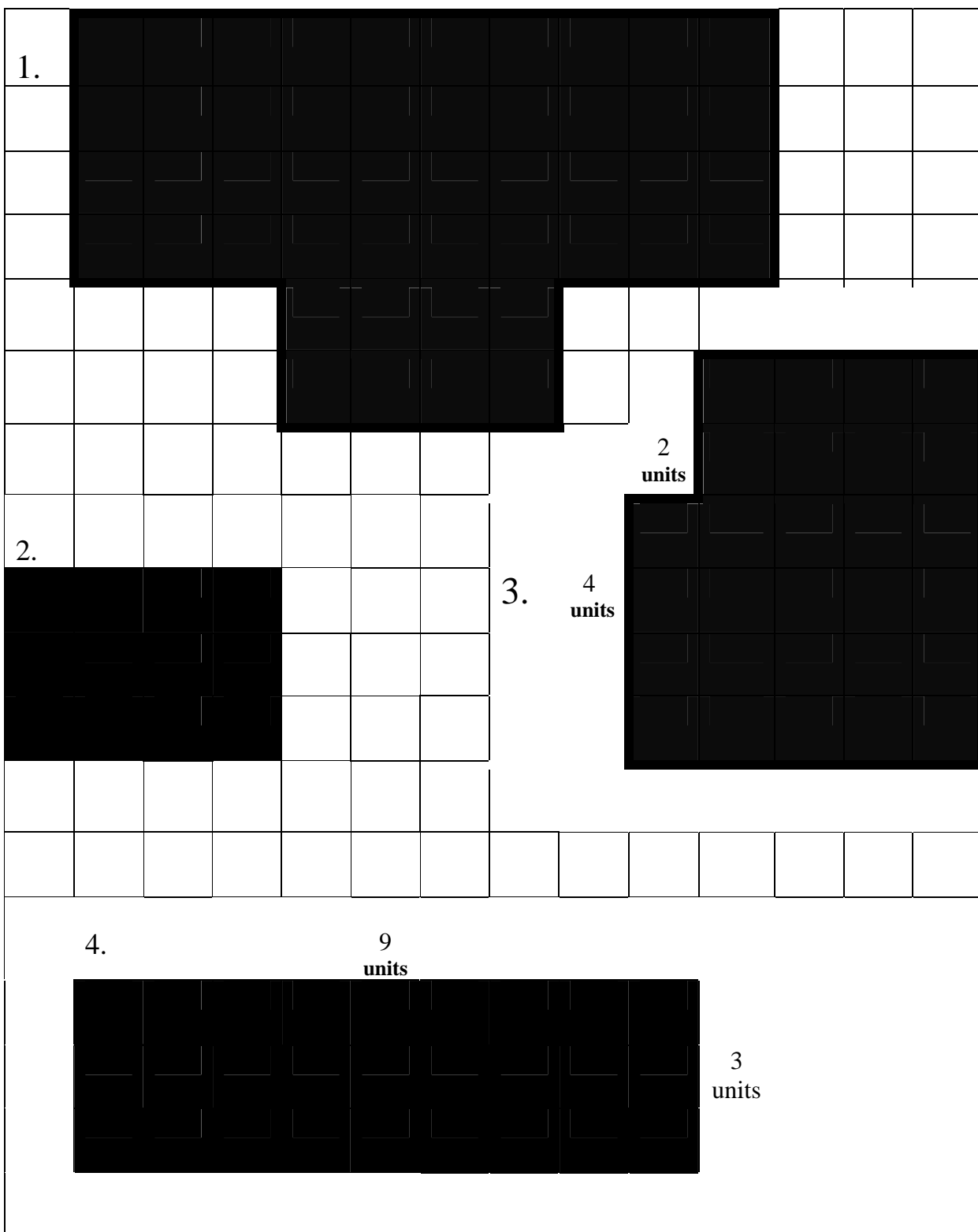


Perimeter = _____

10. The perimeter of a rectangle is 48 inches. Its width is 11 inches. What is the length of the rectangle?

Continue to Practice

Student Resource 6



Plan Your Town

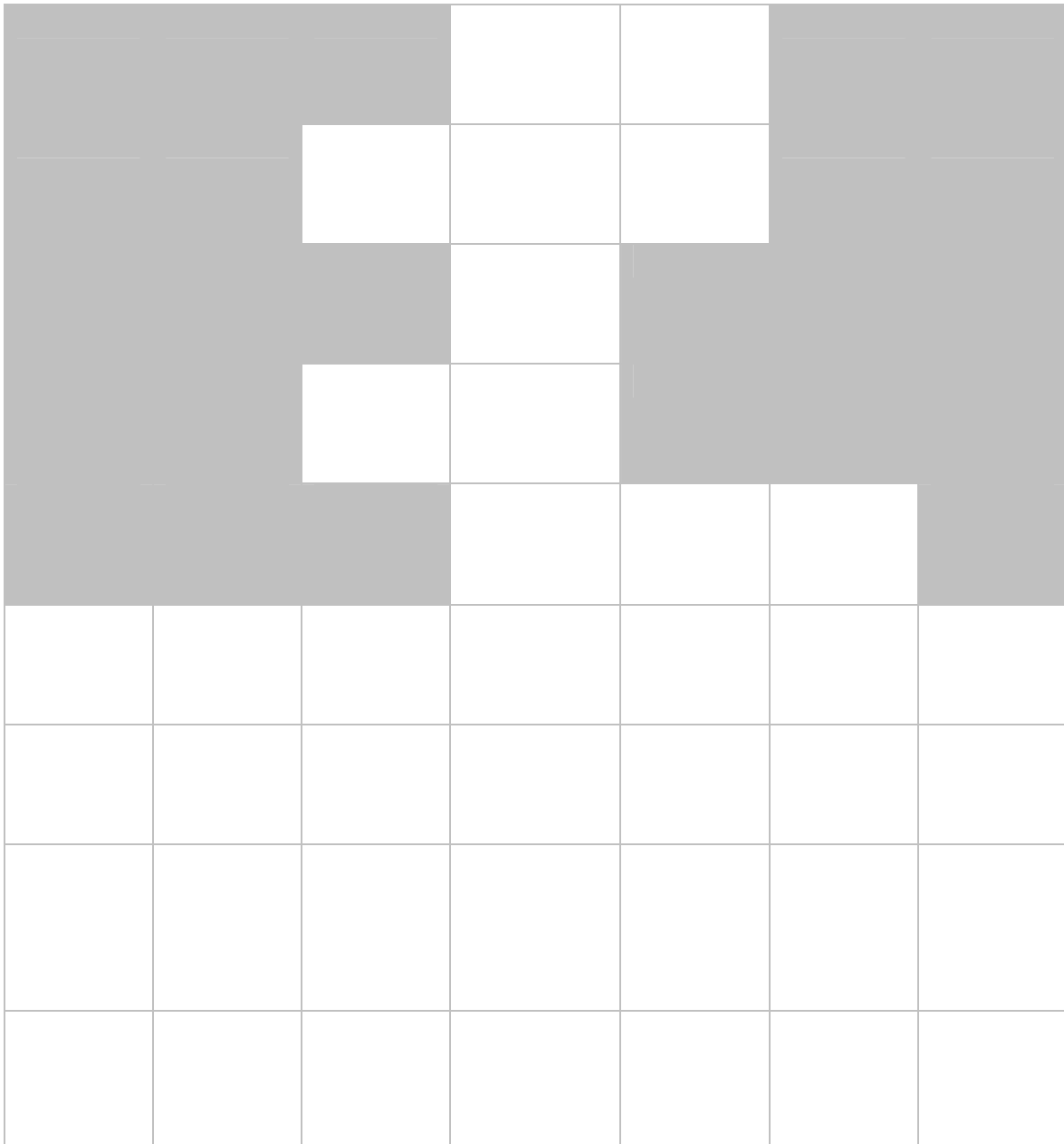
Student Resource 7

[illegible]

[illegible]

Can You Make It Fit?

Student Resource 9



Assessment:

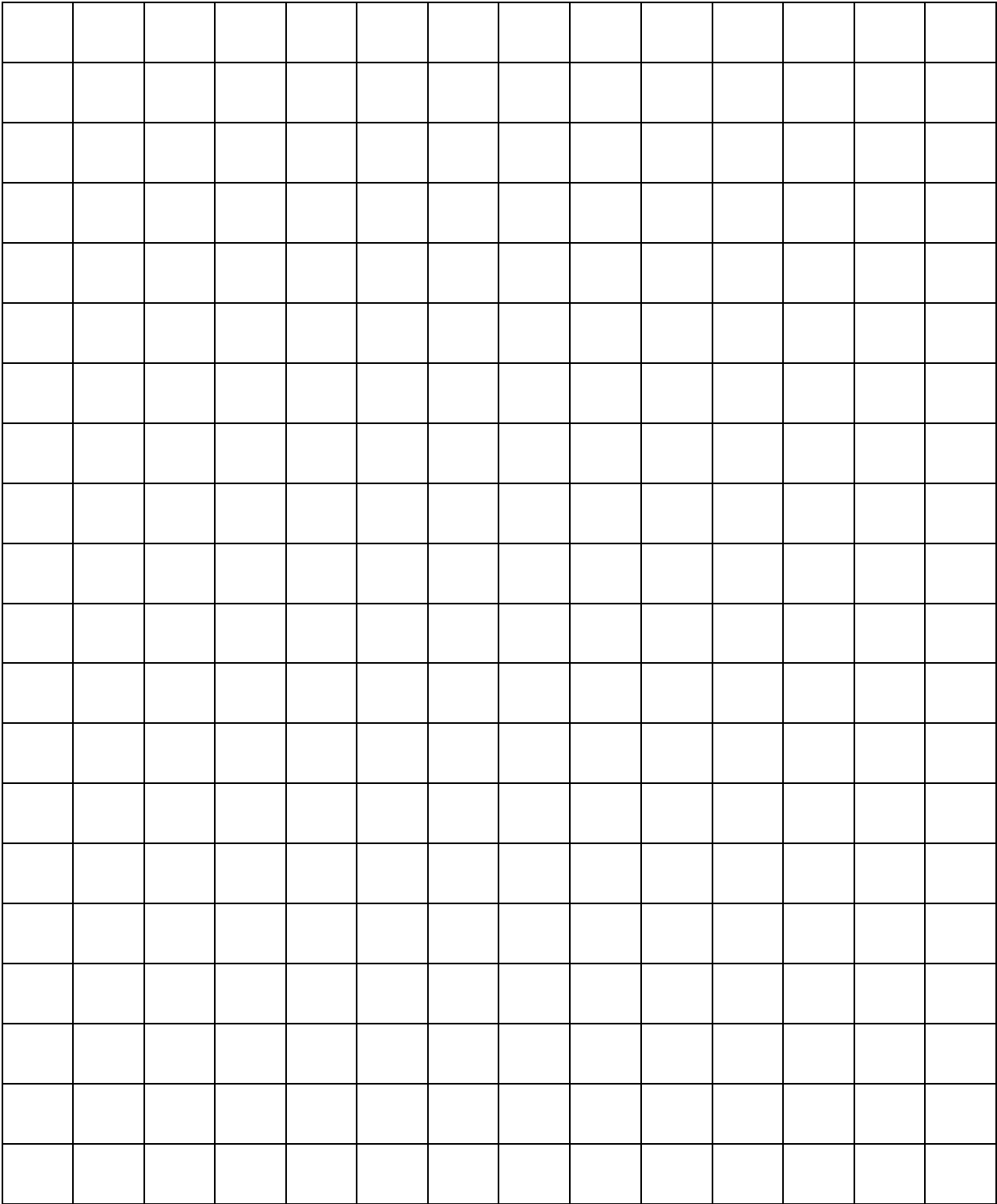
Is it possible to fit a building with a perimeter of ten units between these two building? You may draw on the paper to help you arrive at an answer.

.....

.....

Is your town the same size?

Student Resource 10



After tracing and finding the perimeter of your buildings answer the questions below.
Did the perimeter of your buildings change? _____
Why or why not?_____

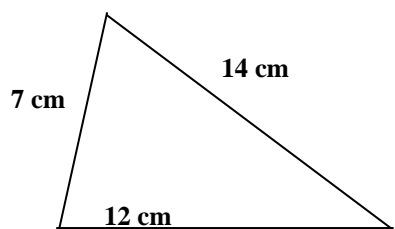
Summative Assessment

Student Resource 11

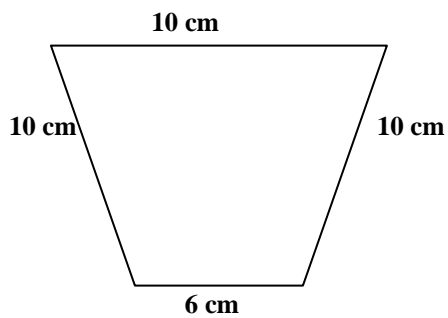
Name _____ Date _____

Selected Response

Find the perimeter of each figure.



p = _____



P = _____

Brief Constructed Response

Step A

The perimeter of a rectangle is 38 yards. Its length is 14 yards. What is the width of the rectangle? Draw a picture of your rectangle below. Then record your answer on the line.

Step B

Use what you know about perimeter to explain why your answer is correct. Use words and/or numbers in your explanation.
